[6450-01-P]

DEPARTMENT OF ENERGY

Production of Tritium in Commercial Light Water Reactors

AGENCY: Department of Energy, National Nuclear Security Administration

ACTION: Record of Decision

SUMMARY: The National Nuclear Security Administration (NNSA), a separately organized agency within the Department of Energy (DOE), is issuing this Record of Decision (ROD) for the *Final Supplemental Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (CLWR SEIS) (DOE/EIS-0288-S1) issued on March 4, 2016.

NNSA prepared the CLWR SEIS to update the environmental analyses in the 1999 Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor (DOE/EIS-0288; the 1999 EIS). The CLWR SEIS provides analysis of the potential environmental impacts from Tritium Producing Burnable Absorber Rod (TPBAR) irradiation based on a conservative estimate of the tritium permeation rate through the TPBAR cladding, NNSA's revised estimate of the maximum number of TPBARs necessary to support the current and projected future tritium supply requirements, and a maximum production scenario of irradiating no more than a total of 5,000 TPBARs every 18 months.

NNSA has decided to implement the Preferred Alternative, Alternative 6, which allows for the irradiation of up to a total of 5,000 TPBARs every 18 months using Tennessee Valley Authority (TVA) reactors at both the Watts Bar and Sequoyah sites. Although near-term tritium requirements could likely be met with the irradiation of 2,500 TPBARs every 18 months, this decision provides the greatest flexibility to meet potential future needs that could arise from various plausible but unexpected events. The exact number of TPBARs to be irradiated during

each/any 18-month reactor core cycle will be determined by both national security requirements and TVA reactor availability.

The CLWR SEIS analyses indicate that there would not be any significant increase in radiation exposure associated with TPBAR irradiation for facility workers or the public. For all analyzed alternatives, estimated radiation exposures would remain well below regulatory limits. The calculated estimated exposures for normal reactor operations with even the maximum number of TPBARs are comparable to those for normal reactor operation without TPBARs.

FOR FURTHER INFORMATION CONTACT: For further information on the CLWR SEIS, or this ROD, or to receive a copy of the CLWR SEIS, contact: Mr. Curtis Chambellan, CLWR SEIS Document Manager, P.O. Box 5400, Albuquerque, New Mexico 87185-5400; 505-845-5073; tritium.readiness.seis@NNSA.DOE.GOV.

For information on the DOE National Environmental Policy Act (NEPA) process, contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (GC–54), U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585; (202) 586–4600, or leave a message at (800) 472–2756. This ROD, the CLWR SEIS, and related NEPA documents are available on the DOE NEPA website at www.energy.gov/nepa and on NNSA's NEPA website at http://nnsa.energy.gov/aboutus/ouroperations/generalcounsel/nepaoverview/nepa/tritiumseis.

SUPPLEMENTARY INFORMATION

Background

NNSA is the lead Federal agency responsible for maintaining and enhancing the safety, security, reliability, and performance of the United States (U.S.) nuclear weapons stockpile. Tritium, a

radioactive isotope of hydrogen, is an essential component of every weapon in the U.S. nuclear weapons stockpile and must be replenished periodically due to its short half-life.

In March 1999, DOE published the 1999 EIS, which addressed the production of tritium in the TVA's Watts Bar and Sequoyah nuclear reactors using TPBARs. The 1999 EIS assessed the potential environmental impacts of irradiating up to 3,400 TPBARs per reactor per fuel cycle (a fuel cycle lasts about 18 months). On May 14, 1999, DOE published the ROD for the 1999 EIS (64 FR 26369) in which it announced its decision to enter into an agreement with TVA to produce tritium in the Watts Bar Unit 1 reactor (Watts Bar 1) in Rhea County, Tennessee, near Spring City; and Sequoyah Units 1 and 2 reactors (Sequoyah 1 and 2) in Hamilton County, Tennessee, near Soddy-Daisy. In 2002, TVA received license amendments from the U.S. Nuclear Regulatory Commission (NRC) to produce tritium in those reactors. Since 2003, TVA has been producing tritium for NNSA by irradiating TPBARs only in Watts Bar 1. After irradiation, NNSA transports the TPBARs to the Tritium Extraction Facility at the DOE Savannah River Site in South Carolina. NNSA's Interagency Agreement with TVA to irradiate TPBARs is in effect until November 30, 2035.

During irradiation of TPBARs in a reactor, a small amount of tritium diffuses through the TPBAR cladding into the reactor coolant; this is called permeation. The 1999 EIS estimated that the permeation rate of tritium through the TPBAR cladding into the reactor coolant system would be less than or equal to 1 curie per TPBAR per year. Based on tritium production experience at Watts Bar 1, NNSA has determined that tritium permeation through the cladding is about three to four times higher than this estimate; nevertheless, tritium releases to the environment have resulted in radiation exposures that are well below regulatory limits. To put this permeation rate into perspective, it represents less than 0.1 percent of the total tritium each

TPBAR produces during irradiation. NNSA has prepared the CLWR SEIS to update the information provided in the 1999 EIS to include: (1) the analysis of the potential environmental impacts from TPBAR irradiation based on a conservative estimate of the tritium permeation rate, (2) NNSA's revised estimate of the maximum number of TPBARs necessary to support the current and projected future tritium supply requirements, and (3) a maximum production scenario of irradiating 5,000 TPBARs every 18 months, which NNSA might require as a contingency capability.

Purpose and Need for Agency Action

U.S. strategic nuclear systems are based on designs that use tritium gas. Because tritium decays at a rate of about 5.5 percent per year (i.e., every 12.3 years one-half of the tritium has decayed), periodic replacement is required as long as the U. S. relies on a nuclear deterrent. The nation, therefore, requires a reliable source of tritium to maintain its nuclear weapons stockpile. Since completion of the 1999 EIS, the projected need for tritium has decreased. Near-term tritium requirements are more likely to be met with the irradiation of 2,500 TPBARs, but this does not exclude the possibility that various potential future events could necessitate increasing TPBAR irradiation, including but not limited to changes in the NNSA's requirements for tritium, or to compensate for a prolonged reactor outage. In any event, the exact number of TPBARs to be irradiated will be determined by both national security requirements and TVA reactor availability, with no more than a total of 5,000 TPBARs (no more than 2,500 TPBARs per reactor) irradiated during an 18-month cycle, an amount that does not exceed the scope of the CLWR SEIS analysis, or the 1999 EIS.

Because NNSA continues to need tritium for nuclear weapons, NNSA's purpose and need for the production of tritium in CLWRs remains the same today as described in the 1999 EIS. However,

current tritium requirements are less than they were in 1999. The observed higher-than-expected tritium permeation rate has resulted in precautionary limitations on the number of TPBARs that the NRC has permitted TVA to irradiate in its reactors.[1] As a result, TVA cannot currently irradiate enough TPBARs in its reactors to meet NNSA's projected future tritium production requirements. The CLWR SEIS supplements applicable environmental analyses in the 1999 EIS to analyze and evaluate the potential effects of the higher tritium permeation to inform decisions related to producing tritium quantities needed to meet national security requirements.

Alternatives Considered

To supply tritium to meet stockpile requirements, NNSA could potentially use one or more of four TVA CLWR units at the Watts Bar and Sequoyah sites (two at each site). These include the units evaluated in the 1999 EIS as well as Watts Bar Unit 2 (Watts Bar 2) which is currently coming online. The SEIS evaluates the potential environmental impacts from TPBAR irradiation for seven alternatives:

The No-Action Alternative is based on the analysis in the 1999 EIS, the Record of Decision for the 1999 EIS, and analyses for NRC license applications and license amendment actions. The 1999 EIS estimated a maximum of 3,400 curies of tritium released from any reactor in a given year. To stay within this maximum 3,400 curies, the SEIS No Action Alternative assumes a conservative release of 5 curies for each TPBAR annually, or a total of 680 TPBARs in any given reactor. This means that the No-Action Alternative assumes irradiation of up to a total of 2,040 TPBARs every 18 months using the reactors identified in the 1999 ROD (Watts Bar 1,

[1] Because of the higher-than-previously-expected rate of permeation, TVA requested, and the NRC approved, a reduction in the number of TPBARs TVA can irradiate per fuel cycle.

Sequoyah 1, and Sequoyah 2) to keep permeation levels under currently approved NRC license and regulatory limits.

Alternative 1 assumes TVA would irradiate up to a total of 2,500 TPBARs every 18 months at the Watts Bar site and would not irradiate TPBARs for tritium production at the Sequoyah site.

Alternative 2 assumes TVA would irradiate up to a total of 2,500 TPBARs every 18 months at the Sequoyah site and would not irradiate TPBARs for tritium production at the Watts Bar site.

Alternative 3 assumes TVA would irradiate up to a total of 2,500 TPBARs every 18 months using both the Watts Bar and Sequoyah sites. This would provide NNSA and TVA the ability to supply requirements using either site independently or to use both sites, with each supplying a portion of the necessary tritium.

Alternative 4 assumes TVA would irradiate up to a total of 5,000 TPBARs every 18 months at the Watts Bar site using Watts Bar 1 and 2. Because TVA would irradiate a maximum of 2,500 TPBARs in any one reactor, this would involve use of both Watts Bar reactors. Under this alternative, TVA would not irradiate TPBARs for tritium production at the Sequoyah site.

Alternative 5 assumes TVA would irradiate up to a total of 5,000 TPBARs every 18 months at the Sequoyah site using Sequoyah 1 and 2. Because TVA would irradiate a maximum of 2,500 TPBARs in any one reactor, this would involve use of both Sequoyah reactors. Under this alternative, TVA would not irradiate TPBARs for tritium production at the Watts Bar site.

Alternative 6 assumes TVA would irradiate up to a total of 5,000 TPBARs every 18 months using both the Watts Bar and Sequoyah sites. Because TVA would irradiate a maximum of 2,500 TPBARs in any one reactor, this could involve the use of one or both reactors at each of the sites.

The following table summarizes these alternatives and provides information about the number of TPBARs analyzed per site as well as the maximum number of TPBARs that could be irradiated every 18 months for each alternative. The maximum number of TPBARs analyzed in the CLWR SEIS for irradiation in a single reactor (as opposed to a single site) is 2,500 TPBARs per fuel cycle versus the 3,400 TPBARs analyzed in the 1999 EIS.

Tritium Production Alternatives

	Alternatives									
	No-Action		**1**	**2**	**3**		**4**	**5**	**6**	
Site	Watts Bar	Sequoyah	Watts Bar	Sequoyah	Watts Bar	Sequoyah	Watts Bar	Sequoyah	Watts Bar	Sequoyah
Reactor Units	1	1 and 2	1 and/or 2	1 and/or 2	1 and/or 2	1 and/or 2	1 and 2	1 and 2	1 and/or 2	1 and/or 2
Number of TPBARs analyzed per site	680	1,360	2,500	2,500	1,250	1,250	5,000	5,000	2,500	2,500
Maximum TPBARs irradiated every 18 months for alternative	2,040		2,500	2,500	2,500		5,000	5,000	5,000	

In the Notice of Intent to prepare the CLWR SEIS (76 FR 60017; September 28, 2011), NNSA stated that it would assess the impacts associated with tritium production in CLWRs based on a permeation rate of about 5 curies of tritium per TPBAR per year. Although the observed tritium permeation through the cladding has been less than 5 curies of tritium per TPBAR per year, the current permeation rate does not take into account potential uncertainties about operating cycle length, tritium production per TPBAR, and future operational changes that could occur at the TVA reactors, all of which could affect the permeation rate.

Given these potential uncertainties in operational parameters, and after consultation with TVA and the Pacific Northwest National Laboratory (the TPBAR design agency), NNSA decided to evaluate an even higher and thus more conservative tritium permeation rate (10 curies of tritium per TPBAR per year) in the CLWR SEIS instead of 5 curies of tritium per TPBAR per year.

NNSA, the Pacific Northwest National Laboratory, and TVA have determined that a tritium permeation rate of 10 curies of tritium per TPBAR per year is the best estimate to ensure that the analyses would reasonably be expected to bound uncertainties in relation to future operations. By analyzing this higher tritium permeation rate, NNSA is confident that the SEIS provides a reasonable, but conservative and bounding, analysis of the potential environmental impacts from tritium production in the Watts Bar and Sequoyah reactors. In addition, the SEIS includes a standalone analysis of the potential impacts associated with a permeation rate of 5 curies of tritium per TPBAR per year for 2,500 TPBARs per 18-month cycle at Watts Bar 1 to provide the most realistic estimate of the potential impacts.

Preferred Alternative

The Preferred Alternative is the alternative the agency believes would ensure its ability to fulfill its statutory mission, giving consideration to environmental, economic, technical, and other factors. In the Draft CLWR SEIS, NNSA identified Alternative 1 as the Preferred Alternative. While, as previously stated, the irradiation of 2,500 TPBARs every 18 months is likely to meet near-term national security requirements, NNSA has determined that responsible planning needs to incorporate the flexibility to address potential future scenarios, including but not limited to a change in tritium production requirements or a prolonged reactor outage. Such events could require NNSA to increase the number of TPBARs that must be irradiated in a given 18-month period. To enable that flexibility, NNSA designated Alternative 6 as the Preferred Alternative in the Final SEIS, because that alternative encompasses the full numerical range of TPBARs that could, under any currently foreseeable circumstances, be irradiated in an 18-month period, at either or both the Watts Bar and Sequoyah sites, to satisfy national security requirements.

Environmentally Preferable Alternative

After considering the potential impacts to each resource area by alternative, NNSA identified the No-Action Alternative as the environmentally preferable alternative. Under the No-Action Alternative, as many as 680 TPBARs would be irradiated every 18 months in each of the following reactors: Watts Bar 1, Sequoyah 1 and Sequoyah 2. If all three reactors were used for tritium production, a maximum of 2,040 TPBARs could be irradiated every 18 months. This is the lowest limiting value considered for the total number of TPBARs proposed to be irradiated under any of the alternatives and consequently would result in less potential environmental impact.

Environmental Impacts of Alternatives

The CLWR SEIS analyzed the potential impacts of each alternative on land use, aesthetics, climate and air quality, geology and soils, water resources, biological resources, cultural resources, infrastructure and utilities, socioeconomics, and human health and safety. The CLWR SEIS also analyzed the potential environmental impacts of each alternative that may result from accidents and intentional destructive acts, transportation, and those associated with waste and spent nuclear fuel management, and environmental justice. The key SEIS findings are: (1) tritium releases from normal operations with TPBAR irradiation would have an insignificant impact on the health of workers and the public; (2) tritium releases from TPBAR irradiation would increase tritium concentrations in the Tennessee River in comparison with not irradiating TPBARs; however, the tritium concentration at any drinking water intake would remain well below the maximum permissible Environmental Protection Agency (EPA) drinking water limit of 20,000 picocuries per liter; (3) TPBAR irradiation would not have a significant adverse impact on the operation and safety of TVA reactor facilities, and the potential risks from accidents would remain essentially the same whether TPBARs were irradiated in a TVA reactor

or not; and (4) irradiation of 2,500 TPBARs in a single reactor would increase spent nuclear fuel generation by about 24 percent per fuel cycle and irradiation of 5,000 TPBARs at a single site would increase spent nuclear fuel generation at either Watts Bar or Sequoyah by about 48 percent per fuel cycle; however, TVA has an infrastructure in place and has a plan to manage the increased volume of spent nuclear fuel assemblies.

The potential environmental impacts of each alternative are summarized for comparison in the Summary and Section 2.5 of the Final CLWR SEIS. Summary Table S-2 and Final CLWR SEIS Table 2-5 provide a summary of potential environmental impacts associated with the Preferred Alternative as well as a means for comparing the potential impacts of the Preferred Alterative with each of the analyzed alternatives.

Public Involvement

NNSA published a Notice of Intent to prepare the CLWR SEIS in the *Federal Register* (76 FR 60017) on September 28, 2011, to invite comments and suggestions on the proposed scope of the CLWR SEIS. NNSA requested public comments by mail, facsimile, or e-mail by the close of the scoping period on November 14, 2011. A public scoping meeting took place on October 20, 2011, in Athens, Tennessee. NNSA considered all scoping comments it received in the preparation of the Draft CLWR SEIS.

In August 2014, NNSA published the Draft CLWR SEIS. The 45-day public comment period on the Draft CLWR SEIS began on August 8, 2014, and ended on September 22, 2014. During the comment period, public hearings were held to allow the public to comment on the Draft CLWR SEIS in Athens, Tennessee, on September 9, 2014; and Chattanooga, Tennessee, on September 10, 2014. In addition, NNSA accepted public comments via mail, e-mail, and facsimile. NNSA considered all comments received in the preparation of the Final CLWR SEIS.

Comments on the Final CLWR SEIS

NNSA distributed the Final CLWR SEIS to Congressional members and committees; State and local governments; other Federal agencies, culturally affiliated American Indian tribal governments, non-governmental organizations, and other stakeholders including members of the public who requested the document. Also, the Final CLWR SEIS was made available via the DOE and NNSA websites. On March 4, 2016, EPA issued the notice of availability (NOA) for the Final CLWR SEIS (81 FR 11557). During the 30 days following publication of the NOA, NNSA received one comment letter from the EPA, dated April 4, 2016. The Appendix to this ROD identifies the comments contained in that letter and provides NNSA's responses. NNSA has concluded that those comments do not identify a need for further NEPA analysis.

Decision

NNSA has decided to implement the Preferred Alternative, Alternative 6, which allows for the irradiation of a total of 5,000 TPBARs every 18 months using both the Watts Bar and Sequoyah sites. Because TVA could irradiate a maximum of 2,500 TPBARs in any one reactor, one or both reactors at each of the sites could be used. For the analyses in the SEIS, NNSA assumed for Alternative 6 that each site would irradiate 2,500 TPBARs every 18 months. However, because the SEIS analyzes the impacts of irradiating up to 5,000 TPBARs at a single site, Alternative 6 is not intended to limit the number of TPBARs irradiated at either the Watts Bar or Sequoyah site, so long as no more than a total of 5,000 TPBARs is irradiated every 18 months, with no more than 2,500 TPBARs in any reactor core.

Basis for Decision

The 1999 EIS discusses NNSA's purpose and need to produce tritium by irradiating TPBARS in one or more CLWRs. That purpose and need remains unchanged and is the foundation for the decision announced in this ROD. In making its decision, NNSA considered potential environmental impacts of operations and activities, current and future mission needs and compatibility, TVA missions and reactor licensing considerations, technical and security considerations, availability of resources, and public comments on the CLWR SEIS.

The selection of Alternative 6 is based primarily on the increased flexibility that it affords to deal with currently unanticipated circumstances. With respect to potential human health and safety impacts, although irradiation of up to a maximum total of 5,000 TPBARs in an 18-month period will increase potential doses to workers and the public, all doses will be well within regulatory limits. The potential use of both the Watts Bar and Sequoyah sites provides both NNSA and TVA the greatest flexibility to meet future tritium production requirements, something the other alternatives do not provide. That is especially true now that four reactors (i.e., the addition of Watts Bar 2) are potentially available to assist in meeting national security requirements.

Mitigation Measures

To mitigate potential impacts from tritium releases, TVA would construct and operate a 500,000-gallon tritiated water tank system at Sequoyah in the event of a decision to irradiate TPBARs at that site or to facilitate routine tritium management. This system would be similar to that at the Watts Bar site. TVA would use the Watts Bar and Sequoyah tank systems to store tritiated water after it passed through the liquid radioactive waste processing system. TVA would release the stored tritiated water to the Tennessee River by the existing pathways. The tank systems that TVA currently has in place at the Watts Bar site and would potentially have in place at the Sequoyah site would have sufficient capacity to store and release the water to the Tennessee

River at appropriate times (that is, TVA will release stored tritiated water from the tank during times of higher river flows for better dilution), and it will enable TVA to minimize the potential impacts of tritiated water releases. The systems would enable TVA to plan fewer releases each year and to ensure that site effluents would continue to remain well below regulatory concentration limits. Additionally, TVA will continue to monitor its operations for emissions to air and water in accordance with its NRC licensing requirements. Lastly, NNSA is continuing TPBAR research efforts, with the goal to reduce tritium permeation into the reactor coolant.

Issued in Washington, DC this 15th day of June 2016.

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Frank G. Klotz
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Appendix: Comments Received on the Final CLWR SEIS

NNSA received one comment letter on the Final CLWR SEIS. That letter, from the EPA dated April 4, 2016, contained comments on three topics which NNSA is addressing in this Appendix to the ROD.

The first EPA comment was a recommendation that radiological and effluent monitoring should continue as the Project progresses. NNSA and TVA agree with this recommendation and note that TVA will continue to monitor its operations for emissions to air and water in accordance with its NRC licensing requirements.

The second EPA comment was a recommendation that the Project Team continue to work closely with any affected communities, regulatory agencies, and other stakeholders as the Project progresses. The EPA specifically identified radiological and effluent monitoring, as well as spent nuclear fuel management, as issues relevant to such coordination. In response to this comment, the NNSA and TVA reiterate their commitment to closely coordinate with any potentially affected communities, regulatory agencies, and other stakeholders as the Project progresses. Notifications of notable Project activities will be posted on both TVA and NNSA public information web sites, as appropriate, and all regulatory requirements will be met in an open and transparent manner. NNSA and TVA welcome public involvement as the Project progresses.

The third EPA comment was a request that the ROD further evaluate the potential consequences of a breached holding tank releasing water containing tritium to the owner-controlled area and flowing to the Tennessee River. Such a scenario is addressed in the SEIS, in Section 1.6, with the conclusion that the EPA drinking water limit of 20,000 picocuries per liter would not be exceeded at the nearest community drinking water intake in the event of an instantaneous release of the maximum expected quantity of tritiated water in the tank. That conclusion is based on the assumption that the tritiated water would be reasonably well-mixed into the river by the time the flow reached the first community system drinking water intake.

In that scenario, the impacts (doses from drinking water consumption) on an annual basis would be no different than currently evaluated in Chapter 4 of the SEIS. In addition, during the NRC 10 CFR 50.59 regulatory process for the tank system, TVA analyzed the potential offsite dose that could result from the rupture of the tank and the release of the entire contents of the tank to the Tennessee River without any holdup or dilution prior to entering the river. The results of that analysis indicated that the offsite dose due to liquid releases (water ingestion, fish ingestion, and recreation) would be less than 0.21 millirem. Airborne offsite doses were calculated to be less than 1.5 millirem. These doses are well below all regulatory limits.

Design features and safety systems for the tritiated water tank system make such an instantaneous release/rupture unlikely. Specifically, the 500,000-gallon stainless steel tritiated water storage tank is set within a larger diameter open tank secondary containment structure to provide full capacity retention. A rain shield over the open containment tank connects to the primary tank above the usable level of the tank, providing a pathway into the secondary containment for all leaks on the side wall of the primary tank. The primary tank also includes an overflow line piped from beneath a top bladder to a 1000-gallon overflow storage tank located in

the annulus between the primary and secondary tanks to contain overfills within the secondary tank. The bottoms of the tanks are separated with a mesh and any leakage between the two tank bottoms is directed to an alarmed sump inside the annulus area to provide leak detection. Piping outside of the tank is run inside a covered highway-rated concrete trench lined with epoxy and provided with a leak detection system.

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